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Interest Rates, Growth, and External Debt

The Macroeconomic Impact of Mexico's Brady Deal

Stijn Claessens
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and
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The debt-relief package worked in Mexico because it reduced uncertainty, not because it reduced transfers.

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This paper — a joint product of the Debt and International Finance Division, International Economics Department, and the Country Operations Division 1, Country Department II, Latin America and the Caribbean — is part of a larger effort in the Bank to study the impact of debt reduction on developing countries. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Rose Vo, room S8-042, extension 33722 (June 1993, 27 pages).

Interest rates fell sharply after Mexico's Brady deal, and private investment and growth recovered.

Claessens, Oks, and van Wijnbergen show that the main benefit of debt relief was not to lower expected payments but to reduce uncertainty. Reduced uncertainty was found to be the dominant factor in explaining the positive macroeconomic response (largely because of its favorable effect on exchange rate crises).

Econometrically, they find that the *variability* of the future net transfer had a significant impact but the *average* of the future net transfer itself did not.

Their results confirm that debt reduction has a positive macroeconomic effect, but reject the "debt overhang" hypothesis (the benefits to growth of a reduced tax burden) as the dominant factor.

Their main conclusion: Debt reduction can have a much greater impact than the magnitude of relief, coupled with standard growth models, would suggest. The secondary effects on private investment of reduced uncertainty about government policy is likely to be more important than the direct amount of debt reduction itself.

But private investment is unlikely to increase if uncertainty remains about future domestic macroeconomic stability and reform. The debt package would not have succeeded if the government had not put through a successful domestic reform program *before* the debt relief package.

INTEREST RATES, GROWTH AND EXTERNAL DEBT: THE MACROECONOMIC IMPACT OF MEXICO'S BRADY DEAL

by

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This paper was written while van Wijnbergen was at the World Bank.

INTEREST RATES, GROWTH AND EXTERNAL DEBT:

THE MACROECONOMIC IMPACT OF MEXICO'S BRADY DEAL

Non-Technical Summary

On March 10 1989, the US Secretary of the Treasury Brady announced US support for external debt reduction (the "Brady plan"). The rationale for supporting what amounts to breach of contract was that debt reduction was considered essential for a restoration of growth and economic stability in the most indebted countries. The Mexican debt package, concluded in 1989 and implemented March 1990, was a spectacular success from that perspective. Interest rates on local currency debt fell by 20 percentage points within days of the agreement, private investment has boomed ever since and economic growth took off for the first time since the debt crisis started in 1982.

The main channel suggested by theory for an impact of debt relief on future growth is a reduced tax burden (the "debt overhang" hypothesis). But even on the most generous of assumptions, this seems implausible. In net present value terms Mexico received about $12 billion debt relief. This would on a permanent basis allow at most a 1.5 percentage point cut in the corporate tax rate.[1/] Econometric evidence suggests that this falls far short of explaining the observed private investment boom of on average 14% real growth for the two years following the Brady deal's implementation.

Much has been made of the impact of the deal on "investor confidence". In this context it is important to notice that the transfer Mexico has to make was not only reduced, but also smoothed out. Thus the specter of recurring crises associated with particular peaks in repayment obligations lost much of its threat as the new debt service obligation schedule was not only less

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1/ Mexico receives about 3.5% of GDP at a 35% corporate tax rate. Due to a comprehensive definition of the tax base and the absence of almost all special credits, average and marginal rates are close. Assuming a conservative 3 percent growth-adjusted real interest rate (real interest rate minus real growth rate) yields the claim stated in the text.

onerous in discounted value terms, but also had a much lower variance. In this paper, we assess the impact of the Brady deal through the channel of increased smoothness of debt service, and explicitly contrast it with the debt overhang hypothesis. We find that reduced variance explains most of the effect of the deal, and that a proxy for the debt overhang effect has no explanatory power at all.

These results confirm the potentially beneficial macroeconomic effects of debt relief, but reject the debt overhang hypothesis as an explanatory factor for them. Econometric evidence presented in this paper indicates that the impact of debt relief on uncertainty is the most important channel through which debt relief influences the macroeconomy. We furthermore sharpen the results by identifying specifically the favorable impact on uncertainty about future exchange rate crises as the dominant mechanism in explaining the growth and investment response to debt relief.

The most important conclusion that follows from our results is that the likely impact of debt service relief can be much larger than the magnitude of the relief coupled with standard growth models would suggest. The secondary effects on private investment through reduced future policy uncertainty are likely to be more important than the direct amount of the relief itself.

Another important result follows also, almost as a corollary; these secondary effects through reduced uncertainty will obviously not come into play unless other, potentially dominant sources of future policy uncertainty have been removed first. Thus the successful domestic reform program that the Mexican government put through in the years preceding the debt package was a necessary precondition for the debt package to be successful. In that sense the debt package was so successful because the Mexicans had been so successful in reforming their economy first; without that the package would not have had such a spectacular effect.

1. INTRODUCTION

On March 10 1989, the US Secretary of the Treasury Brady announced official support for external debt reduction (the "Brady plan"). The rationale for supporting what amounts to breach of contract was that debt reduction was considered essential for a restoration of growth and economic stability in the most indebted countries. The Mexican debt package, concluded in July 1989 and implemented March 1990, was a spectacular success from that perspective. Interest rates on local currency debt fell by 20 percentage points within days of the agreement, private investment has boomed ever since and economic growth took off for the first time since the debt crisis started in 1982.

Such success was not widely anticipated (cf. Dornbusch and Modigliani (1989) for a skeptical assessment); there was a widely shared view that the amounts were simply not enough to make much of an impact. Mexico received about $4 billion cash flow relief per year, 2 of which would likely have come anyhow as amortization could have been expected to be rolled over. In a $200 billion economy, 2 or even 4 billion seems a small tail to wag a large dog.[2/] The optimistic prediction in van Wijnbergen (1989) was based on the assumption that real interest rates would drop by 20 percentage points; this assumption turned out to be correct, but as it was not itself endogenously linked to the debt deal, we are still left with a question mark about the exact mechanisms through which debt relief affects private sector investment and output growth. Oks (1991) also finds a significant impact of the Brady deal on Mexican

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2/ De Long and Eichengreen discuss exactly the same issues in the context of the Marshall plan of 1948.

interest rates: a dummy for the debt deal shows up significantly in a risk premium equation. However, the use of a dummy once again leaves the exact mechanism unspecified.

The main channel suggested by theory for the impact of debt relief on investment, and from there on future growth, is the removal of debt overhang through a reduced tax burden (Helpman (1989), Krugman (1989), Sachs (1990)). But even on the most generous of assumptions, this seems implausible. In net present value terms Mexico received about $12 billion debt relief (van Wijnbergen (1991)). This would on a permanent basis allow at most a 1.5 percentage point cut in the corporate tax rate.[3/] Econometric evidence suggests that this falls far short of explaining the observed private investment boom of on average 14% real growth for the two years following the implementation of the Brady deal.[4/]

Much has been made of the impact of the deal on "investor confidence" (Gurria and Fadl (1991), van Wijnbergen (1991)). In this context it is important to notice that the external transfer Mexico has to make was not only reduced by the deal, but also smoothed out. Thus the specter of recurring crises associated with particular peaks in repayment obligations lost much of its threat as the new debt service obligation schedule was not only less onerous in discounted value terms, but also had a much lower variance. The lengthening of debt maturity brought about by the 1989-90 debt restructuring

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3/ The Government receives about 3.5% of GDP at a 35% corporate tax rate. Due to a comprehensive definition of the tax base and the absence of almost all special credits, average and marginal rates are close. Assuming a conservative 3 percent growth-adjusted real interest rate (real interest rate minus real growth rate) yields the claim stated in the text.

4/ van Wijnbergen (1989) presents econometric evidence on the sensitivity of private investment with respect to the after tax rate of interest.

was the key factor behind the sharp reduction in the variance of the net transfer to foreign creditors. The projected variance of the transfer was further reduced by the issue of fixed-interest rate debt instruments (par bonds).

The importance of smoothness of public debt service obligations for financial stability has been stressed in the literature on domestic debt and financial crises (Giavazzi and Pagano (1989)), but has not received attention in the literature on foreign debt. In this paper, we assess the impact of the Brady deal through the channel of increased smoothness of debt service, and explicitly contrast it with the debt overhang hypotnesis. We find that the reduction in the variance explains most of the effect of the deal. A proxy for the debt overhang effect has no explanatory power at all for the investment recovery, and the results indicate that the debt overhang effect played only a minor role in the reduction in interest rates.

Another important result follows also, almost as a corollary; the effects through reduced uncertainty will obviously not come into play unless other, potentially dominant sources of future policy uncertainty have been removed first. Thus the successful domestic reform program that the Mexican government put through in the years preceding the debt package was a necessary precondition for the debt package to be successful, while the reforms alone were not sufficient to allow for a recovery of investment. In that sense the debt package was so successful because the Mexicans had been so successful in reforming their economy first; without that the package would not have had such a spectacular effect.

The remainder of this paper is organized as follows. In Section 2, we provide a brief overview of macroeconomic developments in Mexico before and

after the package, and a short description of the deal itself. Section 3 then presents a model formalizing the conjecture that the variance of debt service has an important impact on the macroeconomy. Section 4 describes the data used and the regression results. Section 5 concludes.

2. BACKGROUND: DEBT CRISIS, ADJUSTMENT AND THE DEBT REDUCTION AGREEMENT

2.1 Debt Crisis and Adjustment.

Between 1950 and 1974, Mexico enjoyed high growth, low inflation and moderate external debt accumulation. This era of fiscal conservatism came to an abrupt end in the early seventies. The period of single digit inflation ended in 1973, the real exchange rate started to appreciate and the accumulation of external debt accelerated above the GNP growth rate.

A financial and economic crisis in 1976 ended following major oil discoveries in 1977. The ensuing prosperity lasted until 1982, when soaring domestic inflation, falling international oil prices, rising world interest rates and massive capital flight ($21 billion in 1981-82 according to recent estimates; cf. Brideau, Eggerstedt and van Wijnbergen (1992)) led to a refusal by external creditors to roll over the principal payments falling due in that year of about $8 billion of Mexico's external public debt and subsequent reschedulings of Mexican external debt principal repayments.

A sharp real depreciation of the Peso and unprecedented fiscal tightening were necessary to effect a net transfer to foreign creditors of about 5% of GDP in the years following 1982. Economic growth was zero on average over the period 1982-1988. In late 1987 the Government announced the

"Economic Solidarity Pact" (Pacto), which called for accelerated structural reform, further tightening of fiscal and monetary policy, a freeze of minimum wages and basic public and private sector prices, and a freeze of the nominal exchange rate against the U.S. dollar. The Pacto brought inflation down from a three digit level in 1987 to 20% in 1989-1992.

Since more than 90% of Mexico's US$100.8 billion foreign debt outstanding at the end of 1988 was public or publicly-guaranteed, pressures on the Government for reaching an agreement with foreign creditors were building up. High and volatile external transfers generated uncertainty about whether the future transfer burden could be met. This generated increased uncertainty about future exchange rate developments which, in turn, was translated into high interest rates on domestic debt. "Ex post" real interest rates were almost 50% in the months before the debt accord was reached. With domestic public debt at approximately 20% of GDP in 1989, interest rates this high severely threatened the fiscal underpinnings of the stabilization program and led to a reduced level of private investment.

2.2 The Debt and Debt Service Reduction (DDSR) Agreement.

Against this background, debt negotiations started in February 1989, after earlier agreements with Mexico's bilateral (Paris club) and multilateral creditors had been reached. Mexico was the first country to negotiate and obtain a debt and debt service reduction (DDSR) agreement under the Brady Initiative. An agreement in principle was reached on July 23, 1989, and the final package was implemented on March 28, 1990 under which $48,231 million of commercial bank debt was restructured. Of this 47% was committed to a par

bond at unchanged principal but at a reduced, fixed interest rate of 6.25%; 43% was committed to a discount bond at unchanged interest rates but with principal reduced by 35%; and 11% to the new money option, which left both principal and interest rate unaffected but called for 25 cents new money per dollar committed. The package as a whole delivered about $12 billion debt reduction in discounted value terms (van Wijnbergen (1991)).

2.3 Macroeconomic Impact of the Debt Agreement.

When the deal was announced, nominal interest rates on local currency denominated debt dropped 20 percentage points within days. This implied annual savings on domestic public debt service of about 4 percent of GDP, several times the direct impact of the deal on foreign debt service. At the same time, private investment rebounded after years of slow progress if any; real private investment, which had stagnated during 1982-1988 (on average 1 percent growth), grew by 11.2 percent over 1989-1991. 1989 also saw a recovery of economic growth; over 1989-1991, real growth averaged almost 4 percent. The most spectacular reversal took place in the capital account of the balance of payments; on various estimates, around $10 billion flight capital returned in late 1989 and 1990 (Gurria and Fadl (1991), Brideau, Eggerstedt and van Wijnbergen (1992)). And total private capital inflows averaged $21 billion annually in 1991-92.

Interest rates on dollar denominated debt fell too, but by much less than rates on Peso denominated debt ("CETES"). On short term dollar linked instruments ("PAGAFE"), rates fell from around 20% to 16% on an annual basis, or about a fifth of the drop in Peso rates (see Figure 2 on page 11). The

bigger drop in Peso denominated debt strongly suggests the importance of expectations about impending balance of payments crises and their impact on exchange rate sustainability rather than considerations of public solvency.

3. THE MODEL

The model presented below is a simplified implementation of the ideas outlined in Giavazzi and Pagano (1989).[5/] Take the following situation. The private sector has access to foreign and domestic lending and investment opportunities, and is risk neutral. Lack of creditworthiness prevents the government (Central Bank and Treasury combined) to borrow abroad. The government faces variable external debt service payments of B_t in period t, t= 1,...T, and rolls over every period the total principal on its internal debt of D at a nominal interest rate, i_t.

The government can finance the debt service payments B_t and i_t*D in three ways: from its primary surplus (PS), through domestic borrowings, and by a (temporary) increase in the domestic monetary base (monetization). While Mexico has made large fiscal adjustments over the 1980s, in the short-run the primary surplus can not easily be adjusted. This leaves Mexico with the choice between domestic debt financing and monetization. We use α to denote the fraction of the foreign and domestic debt service remaining (after taking account of the primary surplus) that the government decides to monetize. Clearly α is a reflection of the type of monetary policy the government is

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5/The setup here is somewhat different from Giavazzi and Pagano (1989) where the domestic debt service falling due is variable. Here, the main source of variability is the foreign debt service falling due. The results are identical since what matters is that the total debt service falling due net of the primary surplus is variable.

pursuing. Ex-ante, the private sector is, however, not perfectly informed about the conduct of monetary policy and regards α as a random variable, distributed uniformly, $U(0,\alpha_{max})$.

The variability of debt service payments and uncertainty about the conduct of monetary policy can lead to two (or more) equilibria: in one equilibrium the private sector has confidence that there will be no crisis (N); and in the other(s) the private sector is convinced that a crisis is possible (C). The crisis is assumed to take the form of devaluation of the currency. More specifically, in the crisis equilibrium, the private sector believes, because the government may monetizes the share α of debt service due in excess of its primary surplus, that there will be a devaluation of x percent (assumed to be exogenously determined) with probability π. As the domestic currency is fully backed by reserves,[6/] a devaluation is more likely to happen when the government monetizes in order to service its debts. The larger the amount monetized, the higher the chance that the currency will devalue as reserves decline to too low a level (here the lower bound is assumed to be zero) and a speculative attack on the currency occurs. Which of the equilibria (C or N) will prevail will depend on whether the private sector (in rational manner) assigns ex-ante a positive or a zero probability to a devaluation. Both can, under certain circumstances, be rational expectations outcome.

Assume that money demand is of the constant elasticity type: $M = A*e^{-dt}$, where i_t is the domestic interest rate. Consider now what happens to money demand in both equilibria: in N, i_t will be equal to the foreign rate r^*, and $M^N = A*e^{-\alpha^*}$, which will equal the money supply, which equals the reserve level

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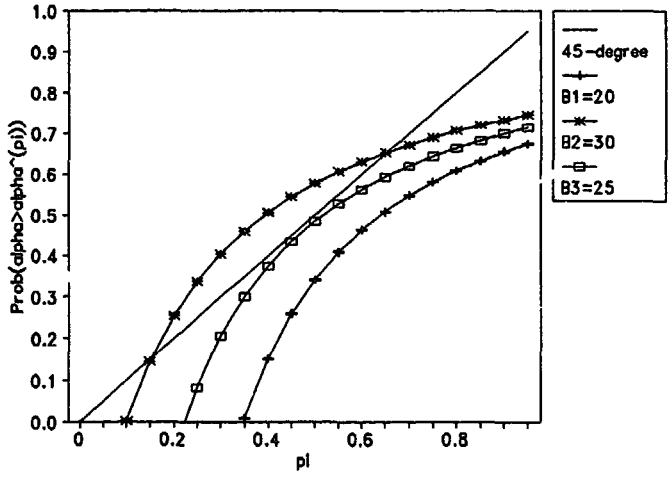
6/We equate the two as we abstract from the domestic financial system.

R; in C, i_t will be the foreign interest rate plus the expected depreciation, and $M^C = A*e^{-\sigma(r^*+\pi x)}$. Moving from equilibrium N to C implies thus a sudden drop in money demand of $A*e^{-\sigma r^*}*(1-e^{-\sigma\pi x}) = R*(1-e^{-\sigma\pi x})$ and a loss in reserves. In the crisis equilibrium, the government will also face a higher interest rate, $r^* + \pi x$, on its domestic borrowings, D, further increasing the chances of an actual devaluation (if the government monetizes the share α of debt service due in excess of its primary surplus).

The fall in money demand and the (temporary) increase in the monetary base will create an actual foreign exchange crisis--the government has to devalue--when $R*(1-e^{-\sigma\pi x}) + \alpha(B_t + (r^*+\pi x)*D - PS) > R$, or, rearranging, when $\alpha > \alpha^\wedge(\pi)$, where $\alpha^\wedge(\pi) = R*e^{-\sigma\pi x}/(B_t + (r^*+\pi x)*D - PS)$. The probability of a devaluation is now defined by the implicit function $\pi = Prob(\alpha>\alpha^\wedge(\pi))$, where $Prob(\alpha>\alpha^\wedge(\pi))$ is equal to $1 - \alpha^\wedge(\pi)/\alpha_{max}$. Figure 1 plots the probability function $P(\alpha>\alpha^\wedge(\pi))$ as a function of π for different levels of B_t. [We use the following parameters: D = 80, σ = 0.05, R = 12, x = 0.5, r = 0.1, PS = 30, α_{max} = 1].

Whether the equilibrium with a positive probability of a crisis can be an outcome will depend on whether the line $P(\alpha>\alpha^\wedge(\pi))$ crosses the 45^0-line. For low values of B this will not be the case, as for B_1 = 20 in this example, while for higher values

Figure 1



it is, as for $B_2 = 30$.[7] As a result, the probability of a devaluation for two different debt service obligations will always be higher than (or equal to) the probability of a devaluation for the mean of the two debt service obligations. In the example, the probability of a devaluation is zero for the mean of the two debt service obligations, $B_3 = 25$, as the line $P(\alpha>\alpha^{\wedge}(\pi))$ does not cross the 45^0-line, while the mean probability of a devaluation for $B_1 = 20$ and $B_2 = 30$ is strictly larger than zero (about 0.32). This implies that domestic interest rates, which will reflect devaluations expectations, will be higher when the variability of debt service payments falling due is large. Any reduction in the variability in expected debt service payments falling due would then lower interest rates. And, because with irreversibility investment will depend negatively on the level of uncertainty (e.g., see Pindyck, 1991), it also implies that investment will increase when the variability in debt service falling due is reduced.

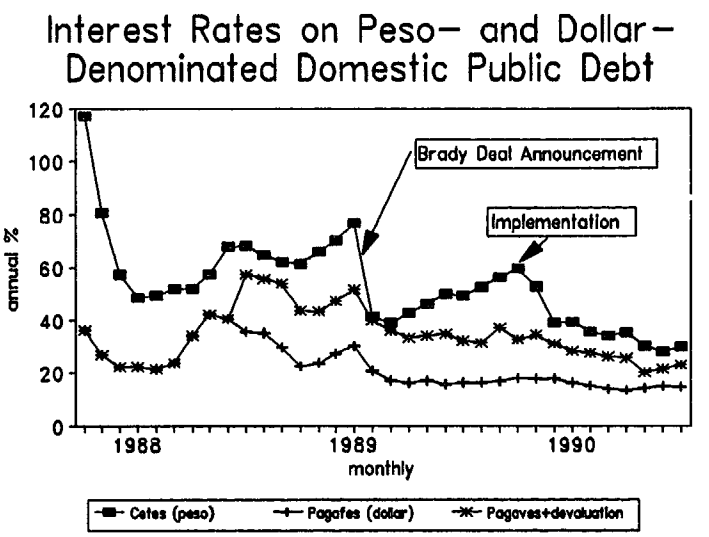
4. EMPIRICAL APPLICATION.

4.1 Data

We look at three Mexican assets to assess the impact of debt service variability on asset prices. The most obvious example is physical capital; because of its irreversibility, the impact of variability-induced rate of return uncertainty is clear. So the first part of the econometric analysis looks at private capital accumulation. An index of private fixed investment is available with monthly frequency.

7/For high levels of B (as in the case of $B_2 = 20$)), there will actually be two possible outcomes for π, a low π and a high π. There is nothing in the model that can determine which equilibrium will prevail.

Figure 2



The second asset we consider is CETES, which is the Mexican local currency equivalent of a T-bill at 28 days maturity. Clearly CETES is a much more liquid asset than investment in physical plant; there are two reasons why even for such short term assets fears of being locked in while a crisis unfolds are in fact not unfounded. The first point is that even 28 days may be too long to get out when a balance of payments crisis with associated exchange rate response threatens. Second, investors may end up getting locked in if capital controls are imposed during or even in the run up to a crisis. Mexico did impose capital controls once before in a period of crisis (August 1982).

Mexico offers a unique opportunity to decompose the interest differential between CETES and equal maturity debt instruments in the US. For this we look at a third asset. The Mexican Government issues a debt instrument similar to CETES, but denominated in dollars (PAGAFE). We can thus split the differential between CETES and the US 1-month T-bill rate in a pure exchange risk component and a pure country risk premium. The first is captured by the CETES-PAGAFE differential (corrected for the preannounced[8/] rate of devaluation), and the second by the differential between PAGAFE and

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8/In the empirical application we use the actual rate of devaluation (see the Data Appendix).

the US T-bill rate. We analyze the response of both interest differentials to measures of the projected net transfer and projected variance of the net transfer to foreign creditors.

Our measure of the projected transfer to foreign creditors is a moving average discounted net transfer (interest plus amortization less disbursements) over the 48 months following the observation. An 8% annual discount factor (or a 0.64% monthly discount factor) is assumed (this was about the LIBOR rate at the time).

We first define the discounted net transfer of month t+i measured at month t (DS_{t+i}) as:

$$(5) \quad DS_{t+i} = (r_{t+i} * F_{t+i} + A_{t+i} - D_{t+i})/(1.0064)^i$$

where: $r_{t+i} * F_{t+i}$ is the interest on the stock of debt at month t+i

A_{t+i}, D_{t+i} are projected amortizations and disbursements at month t+i; 1/1.0064 is the constant monthly discount factor

The average projected net transfer over the following 48 months measured at month t (NT_t) is then:

$$(6) \quad NT_t = \Sigma\ (DS_{t+i})/49 \qquad i = 0...48$$

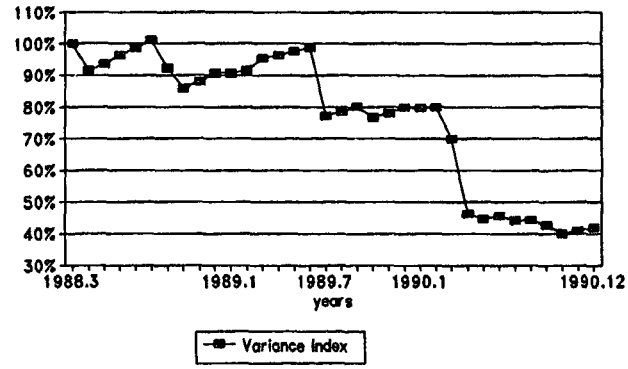
The measure of the variance of the net foreign transfer at time t is:

$$(7) \quad SNT_t = \Sigma\ [(DS_{t+i} - NT_t)^2/(1.0064)^i] \qquad i = 0...48$$

The NT and SNT measures were computed for the period March 1988 to December 1990. The evolution of the variance of the projected net transfer to foreign creditors is shown in Figure 3.

Figure 3

Variance of the Projected Transfer to Foreign Creditors.



4.2 Regressions

The model predicts that a reduction in variability lowers the domestic interest rates and raises investment. As the literature has focussed on the effect of the level of net transfers (the tax in the debt overhang literature), we also investigate whether the interest rate and investment are affected by the average level of net transfers. We first consider the impact on physical capital accumulation and then on interest rates. We then separate out currency risk from more general country risk by analyzing the response of both local currency and dollar denominated Mexican debt instruments.

4.2.1 Debt Relief and Private Investment

Equation (8) links private investment[9/] to the measures of average net transfer and variance of future net transfers using Ordinary Least Squares (OLS). Consider first the debt overhang hypothesis, with NT, the measure of

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9/ The monthly index of private fixed investment published in "Indicadores Economicos" of the Bank of Mexico.

average projected net external transfers, as a proxy for future tax burden (associated with the foreign debt service):

$$(8) \qquad log(Ip) = \underset{(1.32)}{0.856} - \underset{(-0.32)}{0.006*log(NT)} + \underset{(6.34)}{0.808*log(Ip_{-1})}$$

$R^2 = 0.59$ H-Statistic = -1.16 F = 21.6 Sample: 1988.04-1990.12

The value for the H-statistic (the more conventional Durbin Watson test cannot be used because of the presence of lagged endogenous variables on the right hand side of the equation) indicates the absence of serial correlation. While the net transfer variable has the right sign, it is entirely insignificant, with a dismal t-statistic of only 0.32. Inserting the variance measure significantly improves regression performance:

$$(9) \qquad log(Ip) = \underset{(3.30)}{2.276} + \underset{(0.56)}{0.020*log(NT)} - \underset{(-3.03)}{0.146*log(SNT)} + \underset{(2.99)}{0.476*log(Ip_{-1})}$$

$R^2 = 0.69$ H-Statistic = -1.409 F = 32.62 Sample: 1988.04-1990.12

The coefficient of the lagged endogenous variable goes down, and the variance of net transfers enters with the right sign and is highly significant. The debt overhang proxy remains insignificant and now even gets the "wrong" sign. The H-statistic again indicates absence of serial correlation. Not surprisingly, regression performance does not change much when the NT variable is left out:

(10) $log(Ip) = 2.294 - 0.140*log(SNT) + 0.51*log(Ip_{-1})$

(3.37) (-3.02) (3.00)

$R^2 = 0.69$ H-Statistic = -1.256 F = 32.6 Sample: 1988.04-1990.12

The results suggest that NT, the proxy for debt overhang, is not significant, and that the variance of the transfer variable is. An intriguing question is whether the variance variable captures the entire impact of the Brady plan or whether there are other factors at play that we have failed to account for. We test this in an admittedly crude way by rerunning equation (10), but now with an additional "Brady Deal" dummy included[10/]:

(11) $log(Ip) = 2.271 - 0.149*log(SNT) - 0.009*BRADY + 0.477*log(Ip(-1))$

(3.26) (2.64) (0.30) (2.97)

$R^2 = 0.69$ H-Statistic = -1.491 F = 21.1 Sample: 1988.04-1990.12

The Brady dummy enters with the wrong sign and insignificantly. Thus equation (11) strengthens our results: it suggests that the variance measure captures the entire impact of the Brady deal.

These regressions show that the variance index (SNT) was a statistically significant explanatory factor of private investment (Ip) whereas the average projected net transfer (NT) was not. The debt overhang explanation of the macroeconomic impact of debt relief thus finds no support in the data; the

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10/ BRADY = 1 from 1989.07 onwards and zero before that date.

empirical analysis suggests that the impact of debt relief on uncertainty is a more important channel through which debt relief influences the macroeconomy.

4.2.2 Interest Rates and Debt Relief I: Exchange Rate Risk, CETES and PAGAFE

Consider next a similar analysis, but now for CETES. This asset allows us to focus the analysis directly on exchange rate expectations by first looking at the rate differential between CETES and PAGAFE. As already indicated, the difference in currency denomination is the only difference between the two debt instruments. Figure 2 showed the interest rate on CETES and on PAGAFE, with the latter corrected for the preannounced rate of devaluation.

Regressing the interest rate differential corrected for preannounced devaluation, INTDIFF1[11/], on the same set of measures as were used in the investment equation gives similar results[12/]:

(12) INTDIFF1 = -0.162 + 0.076*NT + 0.429*SNT

(-1.01) (0.81) (2.56)

R^2 = 0.77 DW = 1.67 Sample: 1988.3 - 1990.12

11/ $INTDIFF1 = \frac{(1+i)}{(1+i_{PAG})(1+\gamma)}$, with i for CETES, i* for PAGAFE, and γ the preannounced rate of devaluation.

12/ All interest rate equations were estimated using the Maximum Likelihood procedure in SAS assuming first order serial correlation, as the DW statistic in OLS regressions always indicated presence of serial correlation. The DW statistics reported in this section refer to the equation estimated under the assumption of first order serial correlation.

This regression also indicates that the variance of net transfers, rather than the projected net transfer itself, is the main factor behind the dramatic interest rate response to Mexico's debt package. The variance of the net transfer is statistically significant, and the net transfer itself is not. Not surprisingly, almost no explanatory power is lost when the net transfer is left out:

(13) INTDIFF1 = -0.139 + 0.489*SNT

(-0.89) (3.20)

R^2 = 0.76 DW = 1.67 Sample: 1988.3 - 1990.12

Adding the Brady dummy to equation (13) does not change anything significantly:

(14) INTDIFF1 = 0.001 + 0.356*SNT - 0.084*BRADY

(0.04) (1.89) (-1.12)

R_2 = 0.77 DW = 1.70 Sample: 1988.3 - 1990.12

Again the variance term captures all the effects of the Brady plan; the Brady dummy, a proxy for any effects of the deal not taken into account, is insignificant.

4.2.3 Interest Rates and Debt Relief II: Country Risk, PAGAFE and the US Treasury bill rate

Consider finally the differential between PAGAFE and the one month US T-bill, INTDIFF2. Because both are denominated in US dollars, the difference between them is a pure measure of country risk. Regressing INTDIFF2[13/] on the variance and expected value of the net transfer yields the following:

(15) INTDIFF2 = -0.005 + 0.115*NT + 0.07*SNT

(0.02) (1.99) (0.76)

R^2 = 0.80 DW = 1.24 Sample: 1988.3 - 1990.12

Now the variance of the transfer is completely insignificant, and the transfer itself is only borderline significant. The DW statistic is in the middle of the inconclusive range (1.11-1.36) for the relevant number of degrees of freedom; however regressing the error term on its own lag yields a t-statistic on the latter's coefficient of only 1.35, so we did not apply any further error corrections.

Rerunning the equation omitting the insignificant variance term yields similar results, except that the significance of the net transfer term increases:

13/ $INTDIFF2 = \frac{(1+i_{PAG})}{(1+i_{USTB})}$

(16) INTDIFF2 = 0.044 + 0.12*NT

(0.75) (2.34)

R^2 = 0.80 DW = 1.29 Sample: 1988.3 - 1990.12

The DW statistic is now borderline in support of zero residual serial correlation (the inconclusive range is (1.172-1.291). Regressing the error term on its own lag not surprisingly yields a low t-statistic (0.91). Thus no further correction seems warranted.

These results are strikingly different from the ones obtained for investment and the CETES-PAGAFE interest rate differential. The variance plays no role, and the transfer itself only marginally, in explaining the interest rate differential between PAGAFE and the one month US Treasury Bill rate. This fits in well with our hypothesis that it is mostly exchange rate uncertainty that matters; exchange rate uncertainty plays no role in explaining this interest rate differential since both assets are dollar denominated, and the transfer effect captures the partial reduction in country risk.

4.2.4 Summing Up

The empirical results thus confirm the conjecture put forward in the introduction, that the impact of debt relief on uncertainty is the most important channel through which debt relief influences the macroeconomy; and they sharpen our hypothesis by pointing specifically at the favorable impact on uncertainty about future exchange rate crises as the dominant factor in explaining the investment and growth response to debt relief.

The transfer effect is significant in explaining the PAGAFE rate, or country risk; however, one should be aware that the PAGAFE rate dropped only 4 percentage points after the Brady deal. Reduction in pure country risk thus explains only 4 percentage points of the overall drop of 20 percentage points in the differential between CETES and the T-bill rate observed immediately after the Brady deal was announced.

5. CONCLUSIONS

Interest rates fell sharply after Mexico announced the successful conclusion of the negotiations with commercial banks about debt reduction, and private investment and growth recovered sharply. Econometric evidence presented in this paper indicates that the impact of debt relief on uncertainty is the most important channel through which debt relief triggers such macroeconomic effects. The debt relief reduced uncertainty principally by reducing the variability of repayment obligations which, at the time, could not be smoothed out by Mexico as it was credit-rationed. The evidence shows that while the impact of the variance of the projected net transfer on investment is statistically significant, the impact of the projected net transfer itself is not.

Our analysis of the interest rate response furthermore sharpened the results by identifying the favorable impact on uncertainty about future exchange rate crises as the dominant mechanism in explaining the macroeconomic response to debt relief. These results confirm the potentially beneficial macroeconomic effects of debt relief, but reject the debt overhang hypothesis as an important explanatory factor for them.

There is an intriguing analogy with a much earlier episode of large external assistance. In their analysis of the Marshall plan for Europe's reconstruction in 1948, De Long and Eichengreen (1991) show that traditional channels cannot possibly explain the spectacular success of that program. The amounts involved (incidentally as a share of GDP similar to the debt relief Mexico received) are simply too small to have as marked an impact on growth as actually took place. They conjecture that mechanisms rather similar to the one explored in this paper need to be invoked to explain the success of the Marshall plan.

The most important conclusion that follows from our results is that the likely impact of debt service relief can be much larger than the magnitude of the relief coupled with standard growth models would suggest. The secondary effects on private investment through reduced future uncertainty are likely to be more important than the direct amount of the relief itself.

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Data Appendix:

Table 1 lists the data employed to calculate the interest differential between peso-denominated domestic public debt and dollar-denominated domestic public debt adjusted by the preannounced devaluation (INTDIFF1). The interest differential is measured as follows:

$$(1) \quad INTDIFF1 = (1 + i/100)/[(1 + i_{PAG}/100)*(1 + \gamma/100)] - 1$$

i equals the nominal effective annual interest on peso-denominated domestic public debt (Cetes 28 days); i_{PAG} is the nominal effective annual interest on dollar-denominated domestic public debt (PAGAFE 28 days); and γ is the annualized actual devaluation of the peso against the US dollar (there is a minor discrepancy with the preannounced devaluation rate).

Table 1. Interest Differential

	i	i_{PAG}	γ	INTDIFF1
1988:Jan	332.5757	55.06078	36.86948	1.038232
Feb	327.9344	56.8795	0	1.72779
Mar	117.212	36.43456	0	0.59206
Apr	80.52329	26.82091	0	0.42345
May	57.4644	22.28896	0	0.287642
Jun	48.50383	22.27675	0	0.21449
Jul	49.51486	21.48562	0	0.230721
Aug	52.15244	23.92272	0	0.227801
Sep	52.1375	34.43564	0	0.131675
Oct	57.52609	42.35816	0	0.106548
Nov	67.99901	40.51497	0	0.195595
Dec	68.29388	35.65322	16.03831	0.069145
89: Jan	64.85105	35.21051	15.24147	0.057968
Feb	62.01072	29.79448	18.73302	0.051274
Mar	61.47335	22.75371	17.11416	0.123199
Apr	66.11012	23.91036	15.72798	0.158377
May	70.32168	27.60596	15.54275	0.155198
Jun	76.83275	30.33728	16.45815	0.164995
Jul	41.364	21.07369	15.67603	0.009359
Aug	39.18834	17.35334	16.00408	0.022431
Sep	42.79426	16.27664	14.72536	0.070431
Oct	46.41416	17.27109	14.56386	0.089794
Nov	50.01538	15.81136	16.49668	0.111914
Dec	49.39731	16.34658	13.69422	0.129408
90: Jan	52.4814	16.3116	13.04359	0.159706
Feb	56.35786	17.05985	17.13828	0.140284
Mar	59.605	18.025	12.73658	0.19952
Apr	52.931	17.73	14.33424	0.136141
May	39.243	17.871	11.33425	0.061054
Jun	39.394	16.265	10.48151	0.085189
Jul	35.868	15.266	10.76589	0.064167
Aug	34.40904	14.15056	10.66843	0.063963
Sep	35.4787	13.6589	10.57424	0.077987
Oct	30.45391	14.41435	5.290494	0.082898
Nov	28.06388	14.90902	5.858032	0.052807
Dec	29.93647	14.59818	7.440796	0.05532

In Table 2 we report the estimates of the projected net transfer (NT) and the variance of the projected net transfer (SNT). The net transfer projections (i.e., projections of interest, amortizations and disbursements) are "pipeline" projections prepared by the World Bank's External Debt Division. Projections go as far as December 1994 for our latest observation, i.e., December 1990. However, since World Bank projections are only updated in December of each year, the net transfer data employed in the calculation for the months running up to December of the first year was actual (rather than projected) data obtained from the Bank of Mexico. We also assumed that the impact of the debt restructuring on net transfers was perfectly anticipated in July 1989 when the agreement in principle was announced. All this results in the following procedures to construct the net transfer variables used in the estimation: i) for the net transfers projected in 1988 we used the actual monthly net transfers for the months that actually fell in 1988 and World Bank projections (made in 1988.12) for the months after 1988.12; ii) for the 1989.1-1989.6 (prior to the DDSR plan announcement) projections we used actual monthly net transfers for the 1989 months and World Bank projections (made in 1989.12) for the months after 1989.12; and iii) for the 1989.7-1990.12 projections we used actual net transfers until 1990.12 and World Bank projections (made in 1990.12) for the months after 1990.12.

Table 2. Net Transfer (NT) and Variance of the Net Transfer (SNT) (March 1998 = 1)

	NT	SNT
1988:Mar	1	1
Apr	1.043615	0.9136578
May	1.043069	0.9354615
Jun	1.071462	0.9649376
Jul	1.059288	0.9852648
Aug	1.056994	1.0094836
Sep	1.153636	0.9215588
Oct	1.095474	0.8586899
Nov	1.093671	0.8813044
Dec	1.111386	0.9056212
89: Jan	1.128727	0.9060599
Feb	1.140443	0.9144451
Mar	1.188965	0.9542012
Apr	1.153775	0.9631204
May	1.161921	0.9768235
Jun	1.201282	0.9882428
Jul	0.712316	1.5335344
Aug	0.697654	1.5674955
Sep	0.698062	1.5983988
Oct	0.74706	1.5640814
Nov	0.751103	1.5944446
Dec	0.759476	1.6264214
90: Jan	0.743656	1.6489762
Feb	0.729128	1.6751767
Mar	0.577246	0.6995677
Apr	0.662674	0.4631334
May	0.690731	0.4484275
Jun	0.715014	0.4572061
Jul	0.739403	0.44121
Aug	0.751093	0.4433348
Sep	0.775085	0.4275248
Oct	0.811134	0.3995143
Nov	0.810544	0.4087421
Dec	0.82318	0.4174881

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